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288. [Prof. J. H. Kershner, E. J. Edmunds, Geo. Eastwood and Dr. H. Eggers, each sent a solution of this question, but they all lead to complicated equations of a high degree, and are too long for the space that remains at our disposal in this No. We give below the result obtained by Mr. Eastwood.]

Putting r and R for the radii of the two circles, whose centers are O_1 and O_2 , O_1 being the origin and (x_1, y_1) , (x_2, y_2) coordinates of M and N respectively; also putting $AC = \alpha$ and $AB = \beta$, the equation of line MN is

$$y - y_1 = \frac{y_1 - y_2}{x_1 - x_2}(x - x_1). \quad (7)$$

Substituting for x_1, y_1, x_2, y_2 from equations (1), (2), (5) and (6) we get

$$[y(a^2 + r^2) - r(a^2 - r^2)] \cdot [(2R^2r^2a - \beta a^2 - \beta r^2)(\beta - a)^2 + R^2(\beta - 2a)a^2 + \beta R^2r^2] \\ - [2r(R^2 + \beta - a)a^2 - 2R(a^2 + r^2)(\beta - a)^2] \cdot [x(a^2 + r^2) - 2R^2a] = 0. \quad (8)$$

The differential coefficient of (8), with respect to a , equated to zero gives an equation of the 5th degree in a , any real root of which substituted in (8) will give the envelop of MN .

If P denote the middle point of MN the equation of the line CP will be

$$y - r = \frac{r - \frac{1}{2}(y_1 - y_2)}{a - \frac{1}{2}(x_1 + x_2)}(x - a).$$

Combining this equation with (7) we get for the eqn. of the locus of P

$$2y - (r + y_1) = \frac{y_1 - y_2}{x_1 - x_2}(x - x_1) + \frac{r - \frac{1}{2}(y_1 + y_2)}{a - \frac{1}{2}(x_1 + x_2)}(x - a). \quad (10)$$

SOLUTIONS OF PROBLEMS IN NUMBER ONE.

SOLUTIONS of problems in No. 1 have been received as follows:

From R. J. Adcock, 289, 292, 295; Prof. R. C. Arendt, 295; Prof. W. W. Beman, 295; Marcus Baker, 289; Alex. S. Christie, 291; Dr. H. Eggers, 295; Prof. A. B. Evens, 295; George Eastwood, 295; Prof. A. Hall, 295; Prof. W. W. Johnson, 289, 294, 295; Prof. J. H. Kershner, 289, 291, 295; Chas. H. Kummell, 289, 291, 292, 295; Prof. H. T. J. Ludwick, 295; Prof. J. Scheffer, 289, 295; Prof. E. B. Seitz, 289, 291, 295; Walter Siverly, 289; Geo. Lilley, 289; Prof. W. P. Casey, 289, 295.